

Motor Controller for Extreme Environments Based on SiGe, Phase I

Completed Technology Project (2009 - 2009)



Project Introduction

The proposed innovation is a motor-control subsystem capable of operation in extreme environments, including those to be encountered on the Moon and Mars. Specifically, we will demonstrate operation over the environmental range from +130°C down to -230°C during Phase 1, and from +200°C down to -230°C during Phase 2. The switching transistors for the controller will be based on silicon-germanium (SiGe) because of its demonstrated ability to operate well at extreme temperatures. The outcome of this project will be an operating hardware system, not a simulation. This innovation will be applicable to upcoming NASA missions to the surface of the Moon and Mars, as well as to other missions that need controllers for motors and actuators operating directly in extreme environments. Motor-control systems are also needed for space-based observatories, for example for the deformable cryogenic optical systems on the James Webb Space Telescope. Moreover, there are potential applications for extreme-temperature power electronics in the industrial, commercial and defense sectors. The Phase 1 demonstration target is an H-bridge control circuit, pulse-width modulated, for controlling the speed and direction of a 20 W dc motor. The circuit will incorporate four silicon-germanium (SiGe) HBTs, because of their demonstrated advantages for extreme-temperature operation. In addition, the proposing organization, GPD Optoelectronics Corp., has developed SiGe power transistors that operate down to -230°C. The drive circuitry will use optoelectronic coupling. Suitable packaging technologies for the extreme environment will be developed and reliability testing will be performed. A complete prototype system will be delivered at the conclusion of each Phase. The proposed motor-control subsystem is an innovation because there are presently no such subsystems capable of operation over the extreme-environment range from +130°C or +200°C down to -230°C.



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

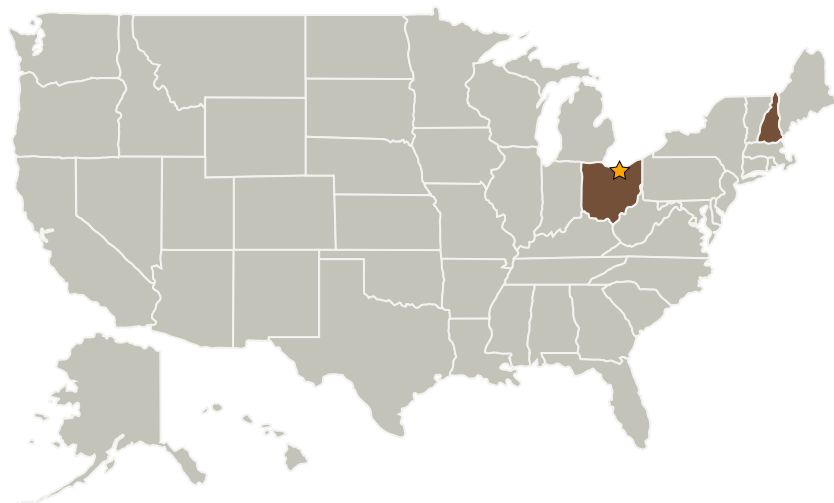
Small Business Innovation Research/Small Business Tech Transfer

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
GPD Optoelectronics Corporation	Supporting Organization	Industry	Salem, New Hampshire

Primary U.S. Work Locations

New Hampshire	Ohio
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Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX02 Flight Computing and Avionics
 - └ TX02.1 Avionics Component Technologies
 - └ TX02.1.1 Radiation Hardened Extreme Environment Components and Implementations